FORECASTING AIR POLLUTION POTENTIAL[1]

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ABSTRACT

A procedure for forecasting weather conditions conducive to high air pollution levels over a large area as a primary alerting system for potentially hazardous conditions is presented. Experiments conducted in the fall of 1957 and 1958 to test the procedure are described. The results indicate that forecasts of macroscale meteorological phenomena can be used to signify periods of high air pollution potential.

1. INTRODUCTION

Discharge of pollutants to the air during meteorological conditions conducive to their congestion could be reduced or eliminated for many sources of pollution provided adequate and dependable warning of the conditions were given. When conditions are favorable for rapid dispersion and diffusion of contaminants, higher rates of discharge are usually possible without creating undesirable effects. Occasionally meteorological conditions develop which inhibit dispersion of air-borne wastes for extended periods. Forecasts of the latter conditions, coupled with measurements of air quality, could provide a basis for pollution control.

A forecast of unfavorable atmospheric conditions would alert interested parties, both public and private, to take precautionary measures. Measurements of local air contaminants could then be initiated to monitor the air quality. If these measurements attained prescribed values and the forecast indicated that meteorological elements necessary to the accumulation of contaminants were expected to persist, then appropriate steps could be taken to reduce or eliminate the emission of pollutants until the measurements and the forecast show that normal activity could be resumed.

2. EFFECTS OF WEATHER ON DISPERSION OF AIR POLLUTANTS

Experience and investigation have shown that wind speed and atmospheric stability are the weather elements which may be considered as the primary meteorological factors that determine the dilution of air pollution in the lower atmosphere.

The volume of air into which contaminants are emitted is directly proportional to wind velocity, and the concentration of contaminants is generally inversely proportional to wind speed. If the wind speed doubles, other conditions being equal, the pollutants are emitted into twice the volume of air downstream from the source.

Stability depends on the temperature distribution with height. Normally temperature decreases with height approximately 3.3° F. per 1000 feet. When the decrease is greater than the dry adiabatic lapse rate (5.5° F. per 1000 feet), the air is unstable and vertical exchange and turbulence occur readily. When the decrease is less than 5.5° F. per 1000 feet or when the temperature increases with height, the air is stable and turbulence tends to be damped out. Theoretically the damping becomes greater as the temperature decrease with height lessens and is pronounced in an inversion layer. An inversion is that condition in the atmosphere when the temperature increases with height.

3. SELECTION OF FORECAST MODEL

Studies of air pollution episodes at Donora [1], Greater London [2], and other places have suggested that the simultaneous occurrence of very low wind speed, variable wind direction, pronounced stability, and fog is characteristic of these episodes. Furthermore, these conditions persisted for several days during each episode and were associated with quasi-stationary anticyclones.

On the basis of this knowledge a set of empirical criteria was selected as a foundation for forecasting air pollution potential. These criteria embody meteorological conditions which are associated with slowly moving anticyclones and are most likely to produce the conditions discussed above. These criteria are: (1) Surface winds less than 8 knots. (2) Winds at no level below the 500-mb. level greater than 25 knots. (3) Subsidence, the slow sinking or settling of air from aloft, below the 600-mb. level. (4) Simultaneous occurrence of the above with the forecast continuance of these conditions for 36 hours or more.

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4. EXPERIMENTAL DESIGN

An experiment was designed to test the applicability of the given criteria as precursors of pollution episodes. The experiment was limited in time to the season during which stagnating anticyclones are most likely to occur [1, 3], and in area to the region in which stagnating anticyclones most frequently occur [3]. Secondary consideration was given to availability of air quality measurements.

The selected area (fig. 1) extends from 33° N. to 43° N. and from 78° W. to 88° W., or roughly, that area bounded by Myrtle Beach, S.C.; Tuscaloosa, Ala.; Milwaukee, Wis.; and Buffalo, N.Y.[3]

The operators in charge of National Air Sampling Network stations in this area volunteered to collect the air quality data necessary to determine the success or failure of forecasts for high pollution potential. Analytical work was done by the National Air Sampling Network (NASN) of Air Pollution Engineering Research at the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Suspended particulate material collected over 24-hr. periods by high volume air samplers was used as the air quality measurement.

The daily weather was monitored over the selected region from October 1 to November 15, 1957 and from September 1 to November 15, 1958. Whenever weather conditions met the selected criteria in a minimum area (equivalent to a 4° square) and a forecast indicated that they would persist, a request for air quality measurements was relayed by telegram to appropriate NASN stations.

5. RESULTS

During the two test seasons, six periods were observed in which the criteria were met. Each period will be discussed in terms of the dominating weather influences, the air quality measurements obtained at each station during each episode, and comparable air quality measurements collected by the individual stations during the year. (National Air Sampling Network Stations take air quality measurements on a random basis; one 24-hr. sample is taken during each 2-week period.)

CASE 1

The first period occurred during October 11–15, 1957. An analysis of the weather data during this period shows that the region was under the influence of a slowly moving polar anticyclone, which began to affect the test area early on October 10. By the 11th, surface winds and winds aloft (table 1) were well within the criteria over northern Indiana and northern Ohio. By the 12th, light winds prevailed over southern Ohio and western Pennsylvania. Atmospheric soundings taken at Peoria (fig. 2), Dayton (fig. 3), and Pittsburgh (fig. 4) indicated the presence of subsidence. The surface anticyclone was

[3] Cities given in tables 2–5 and 7 outline the sub-areas within the test area where the criteria were met during a particular air pollution episode.

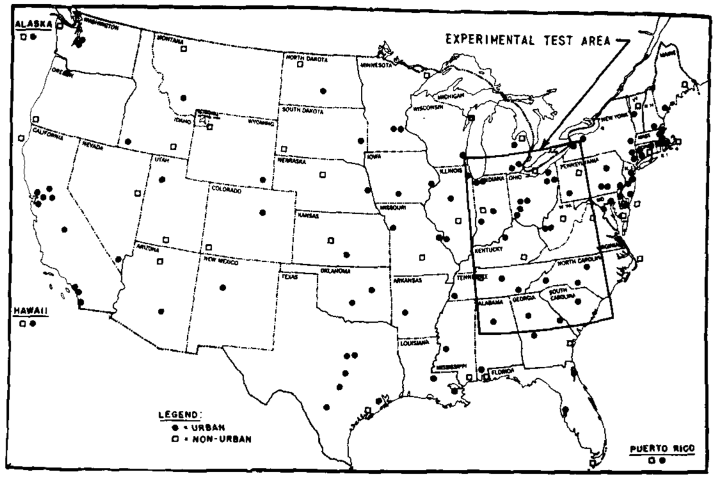

FIGURE 1.—National Air Sampling Network, June 1958. The experimental test area extends from 33° N. to 43° N. and from 78° W. to 88° W.

TABLE 1.—*Wind speed (knots) at selected stations 1300 EST, October 11–16, 1957*

Height (meters MSL)	Dayton, Ohio						Flint, Mich.						Pittsburgh, Pa.					
	11	12	13	14	15	16	11	12	13	14	15	16	11	12	13	14	15	16
6000	26	13	0	13	27	31	22	4	11	11	18	56	37	7	18	11	18	20
5000	20	13	7	11	25	40	26	7	18	16	25	45	29	13	16	11	18	25
4000	13	18	13	11	22	45	24	7	20	22	22	47	24	20	11	13	16	16
3000	11	11	9	9	22	47	22	7	22	16	31	51	18	11	9	9	4	20
2500	11	7	11	9	18	51	15	7	13	13	22	40	13	9	7	16	2	13
2000	11	11	11	7	20	49	11	7	4	13	18	31	13	7	2	11	4	11
1500	13	11	7	4	18	49	7	2	2	11	16	29	13	4	2	9	11	13
1000	9	13	7	2	13	45	11	4	4	11	18	42	13	7	4	7	9	13
500	15	13	7	7	7	22	9	4	4	7	11	27	13	7	7	4	2	9
*300	13	16	7	4	9	27	9	4	4	7	13	31	15	7	4	7	4	13
*150	15	13	7	7	7	20	9	4	4	7	11	22	13	7	7	4	2	9
SFC	15	9	9	7	9	16	7	1	7	9	11	11	13	7	7	7	0	9

*Height above surface.

TABLE 2.—*Particulate matter concentrations (μg.m.^−3) for National Air sampling stations, 1957*

Alerted October 11–15, 1957

Fort Wayne, Ind.	Indianapolis, Ind.	Columbus, Ohio	Lorain, Ohio	Lake County, Ind.		Pittsburgh, Pa.	Wheeling, W. Va.
				Site A	Site B		
70	87	77	55	66	**74	78	137
72	87	108	68	**121	101	79	143
79	106	114	69	128	107	82	150
85	111	125	75	142	147	103	152
89	119	132	78	205	152	103	155
91	123	132	84	215	155	104	157
102	123	136	105	239	162	126	159
105	125	145	114	255	180	136	163
109	127	159	116	272	192	159	165
110	128	164	117	*274	195	168	169
114	135	166	122	276	205	178	170
117	140	169	122	298	229	179	175
121	141	175	124	322	230	179	178
127	143	176	127	327	262	180	197
128	146	180	136	371	270	186	207
132	151	186	138	426	280	198	212
135	155	189	145	459	282	209	213
136	*158	191	159	479	298	252	215
138	166	211	162	978	*305	253	217
138	176	222	182		363	348	232
162	177	*226	215		545	397	277
*185	178	234	247			449	278
189	199	234	279			*534	*291
*198	200	241	298				292
202	217	*241	343				344
206	260	248	*398				
*244		248					
304		*274					
		310					

*Episode data.
**Post episode data. Samples taken after termination of alert.

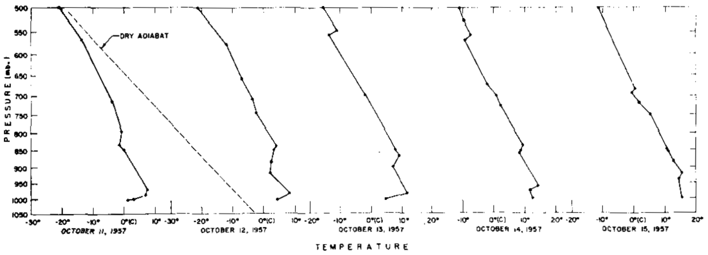

FIGURE 2.—Radiosonde observations, Peoria, Ill., 0700 EST, October 11–15, 1957.

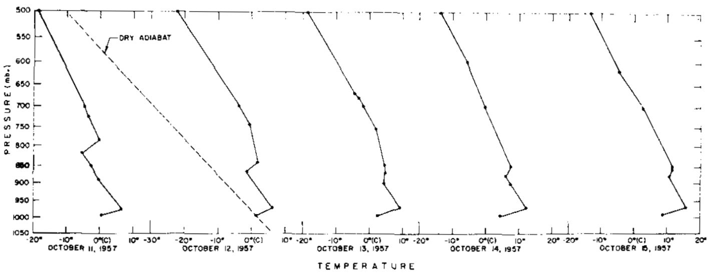

FIGURE 3.—Radiosonde observations, Dayton, Ohio, 0700 EST, October 11–15, 1957.

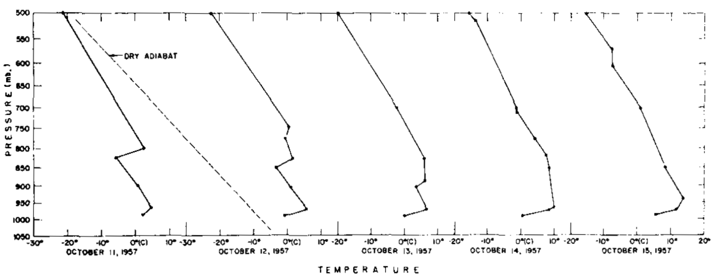

FIGURE 4.—Radiosonde observations, Pittsburgh, Pa., 0700 EST, October 11–15, 1957.

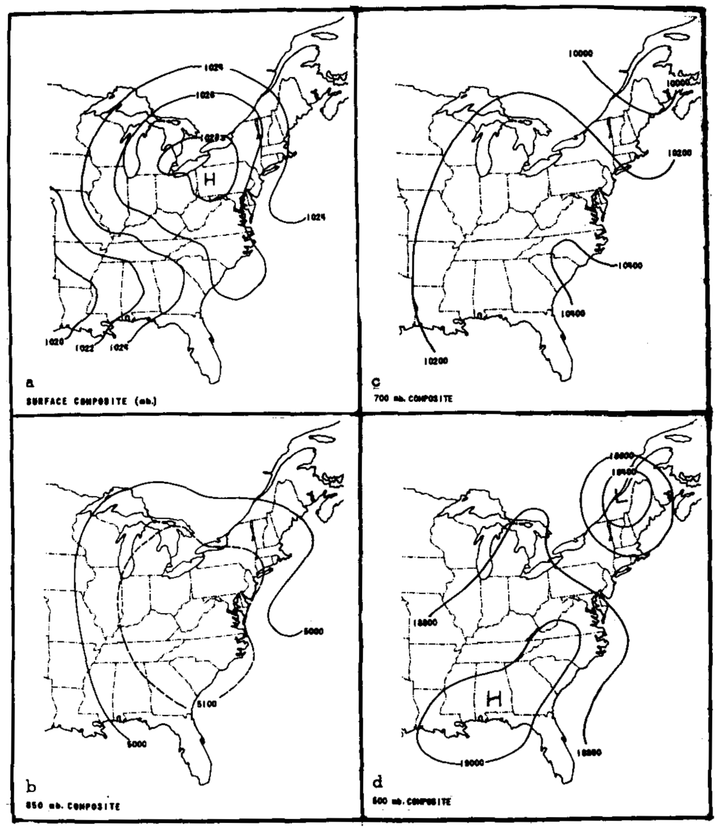

FIGURE 5.—Average meteorological charts, October 11–15, 1957. (a) Sea level composite pressure (mb.), 0100 EST. (b) 850-mb. composite height (ft.), 1900 EST. (c) 700-mb. composite height (ft.), 1900 EST. (d) 500-mb. composite height (ft.), 1900 EST.

accompanied by a well-developed ridge of high pressure aloft (fig. 5) and although the anticyclone did not stagnate, light winds, clear skies, and well-developed surface inversions prevailed during the period.

These meteorological conditions led to subnormal dispersion of contaminants and were instrumental in effecting high pollution levels. Table 2 presents the air quality data collected during the period in addition to data collected for the NASN by each station in 1957. In most instances, the requested measurements fell in the upper quartile for the year. For two stations, the values were the highest recorded in 1957.

An inspection of the local wind pattern in relation to the industrial and residential distribution in a Lake County, Indiana city gives a possible explanation for the difference in sampling values at the two stations during the October 13–14, 1957, sampling period. Wind directions ranged from ENE to SSE during this period. Winds from these directions favor the movement of industrial pollutants toward station B. The air passing over station A for these wind directions would pass primarily over a residential area before reaching the sampler.

The alert was terminated for the northwestern Indiana city and other cities on the afternoon of the 14th when it became apparent that the pressure gradient was intensifying and that strong surface winds would prevail over Indiana and western Ohio. Nevertheless a 24-hr. sample (October 14–15) was collected at two stations in a Lake County, Indiana city. The values recorded were 121 μg.m.$^{-3}$ at station A and 74 μg.m.$^{-3}$ at station B. These values are both within the lower decile of the 1957 data for these stations.

CASE 2

A request for air quality samples was issued in conjunction with a forecast on the afternoon of September 5, 1958. Since the telegrams did not reach the station operators before the close of the business day, no special samples were collected. A regular NASN sample collected at Greensboro, N.C., one of the stations to which a telegram was sent, fell in the upper decile of recorded 1958 data (see table 10).

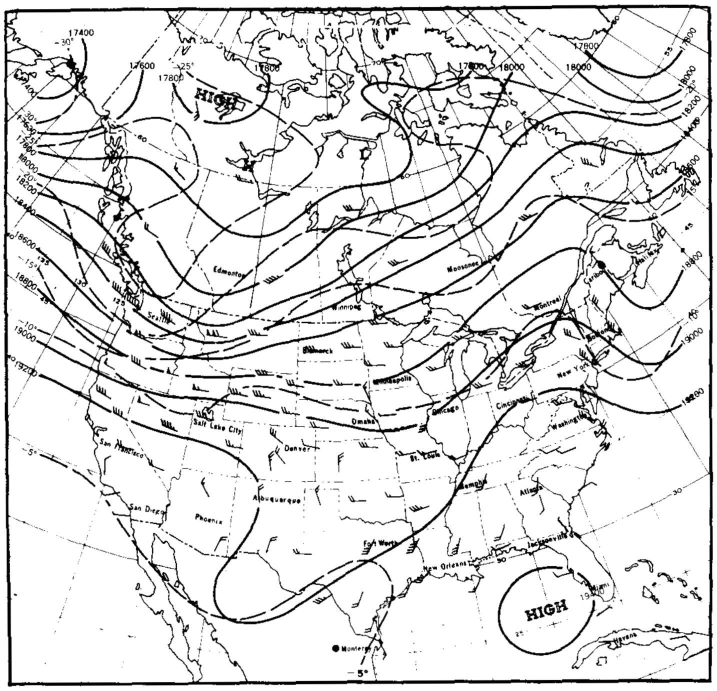

FIGURE 6.—500-mb. height chart, 1900 EST, September 19, 1958.

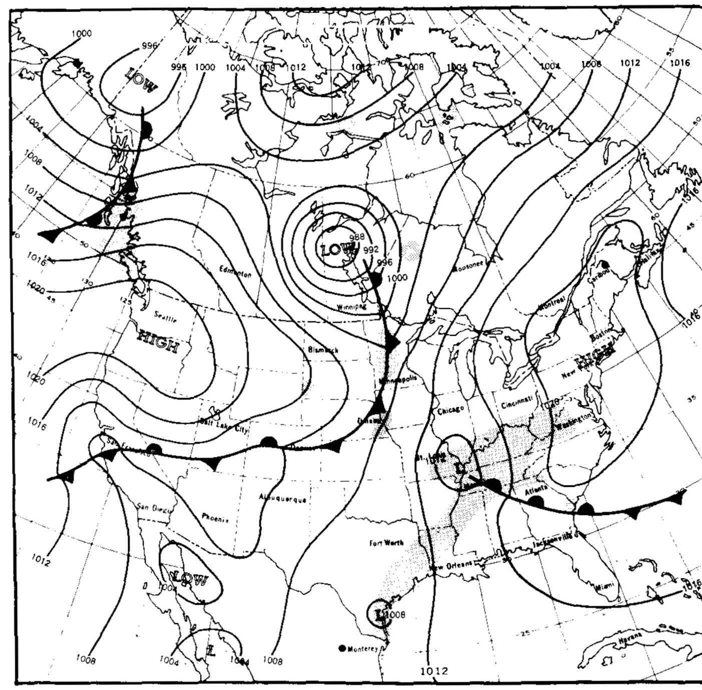

FIGURE 7.—Sea level pressure chart, 1300 EST, September 20, 1958.

CASE 3

On September 19, 1958, a surface high pressure system was centered over northern Ohio with an upper level ridge over the same general area. Available information indicated that the ridge would intensify and persist. However, cyclonic circulation developed at the 500-mb. level over the Texas Panhandle. It was detectable on the 1900 EST, September 19, 1958, 500-mb. chart and moved northeastward with the flow shown on figure 6. By the afternoon of September 20, a surface cyclone had developed and subsequently moved through the area of concern (fig. 7). Considerable precipitation, widespread cloudiness, and relatively strong wind flow were associated with the cyclone. The surface high pressure system moved rapidly eastward and was centered over Connecticut at 1300 EST, September 20 (fig. 7). A surface ridge extended over western Pennsylvania and eastern Ohio.

TABLE 3.—*Particulate matter concentrations* ($\mu g.m.^{-3}$) *for National Air Sampling Network Stations, 1958*

Alerted September 19–22, 1958

Akron, Ohio	Asheville, N.C.	Charleston, W. Va.	Charlotte, N.C.	Cincinnati, Ohio	Columbus, Ohio	Detroit, Mich.	Greensboro, N.C.	Jackson, Mich.	Pittsburgh, Pa.	Youngstown Ohio
44	*43	45	43	*42	*54	54	34	11	*83	79
*63	45	47	55	*81	78	65	*40	29	85	80
68	45	*52	*55	89	86	79	41	30	89	87
83	47	71	62	91	*100	80	41	32	89	89
84	48	71	66	93	108	91	*46	37	*97	*110
98	49	78	66	96	112	100	47	46	98	114
*99	*54	87	69	99	123	*100	63	46	102	*118
99	54	88	69	100	125	109	64	*53	103	119
100	64	89	82	113	126	114	67	55	115	120
101	66	92	86	117	*131	114	68	59	124	123
101	66	96	88	124	135	115	69	61	125	130
101	*71	*102	88	126	136	118	70	65	131	135
101	73	120	98	126	138	119	73	69	132	140
104	74	143	102	128	140	124	77	69	135	146
105	75	150	102	132	140	127	77	76	140	148
107	77	167	110	133	140	137	*77	76	140	150
113	78	178	113	134	146	140	80	77	144	153
126	82	195	127	135	148	143	89	77	150	154
127	95	*228	136	149	151	159	90	81	150	158
139	107	231	137	149	154	*186	97	84	152	159
140	108	232	*148	149	158	196	98	91	167	160
150	115	308	152	150	159	210	108	*92	178	166
164	121	336	168	180	174	217	126	93	212	170
*170	124	412	188	190	191	218	133	93	213	194
177	131	483	216	206	194	225	137	*93	230	212
198	179	708	236	259	219	246	156	94	257	*254
328	206		268	319	232			102	302	268
330	212		308		241			128	330	391
431					241				*343	
									344	

*Episode data.

Air quality data for the September 19–22, 1958 period are given in table 3 among the 1958 data collected by the participating stations. It can readily be seen that these samples are low with few exceptions. The relatively high values at Jackson, Youngstown, and Pittsburgh may be attributed to the fact that these stations are located well to the north and east of the area in which the cyclone developed. They were under the influence of the high pressure cell during the period September 19–20 when the high samples were collected. As the low pressure system moved eastward, surface wind speeds increased at these stations and the air quality improved.

CASE 4

The weather pattern of October 3, 1958 presented an opportunity to collect air quality data under conditions of only two of the criteria. Since there was visual evidence of air pollution, it was decided to request two 24-hr. air quality samples from each station listed in

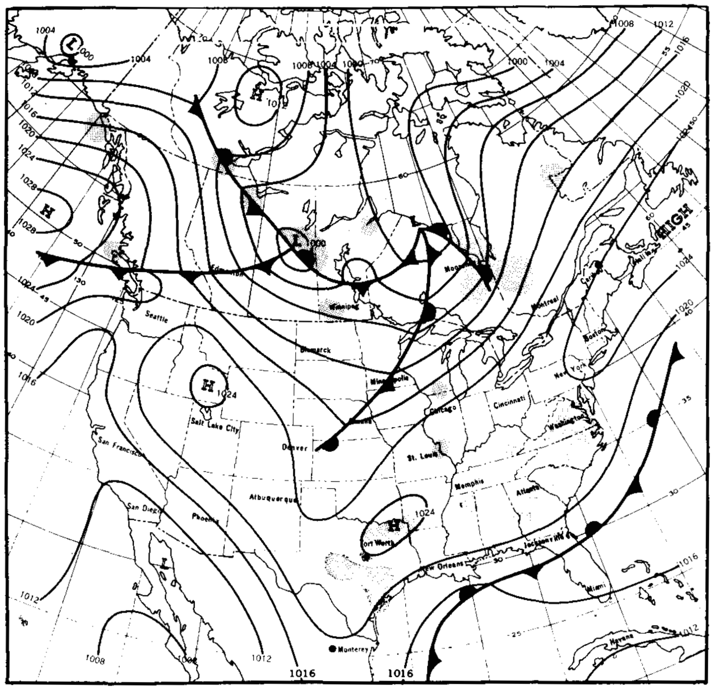

FIGURE 8.—Sea level pressure chart, 1300 EST, October 3, 1958.

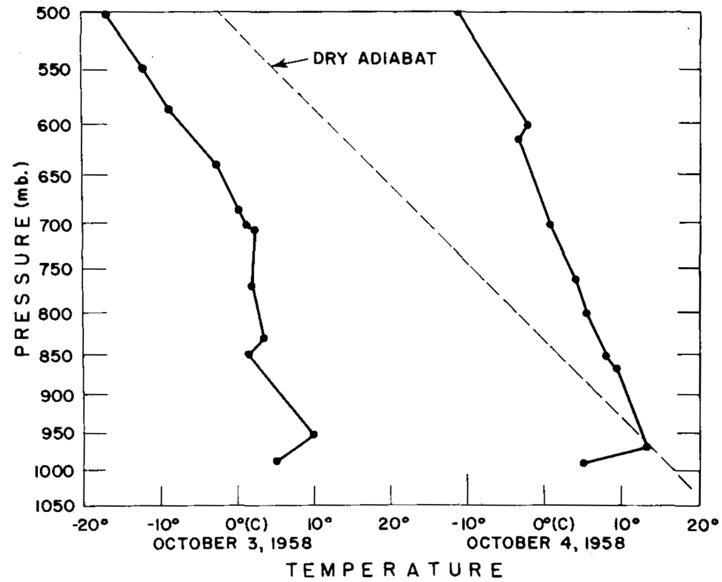

FIGURE 9.—Radiosonde observations, Dayton, Ohio, 0700 EST, October 3–4, 1958.

table 4 to determine the relative magnitude of the air quality under these conditions.

A surface high pressure cell was centered off the coast of Nova Scotia and a weak ridge of high pressure extended southwestward to Texas (fig. 8). Surface winds were light and variable and early morning radiosonde observations at Dayton (fig. 9) and Pittsburgh (fig. 10) indicated well developed surface inversions and subsidence

TABLE 4.—*Particulate matter concentrations* ($\mu g.m.^{-3}$) *for National Air Sampling Network Stations, 1958*

Alerted October 3–5, 1958

Cincinnati, Ohio	Columbus, Ohio	Huntington, W. Va.	Pittsburgh, Pa.
89	78	50	85
91	86	58	89
93	108	*59	89
96	*108	61	98
99	112	63	102
100	123	67	103
*108	125	68	115
113	126	74	124
117	135	75	125
124	136	77	131
126	138	*90	132
126	140	91	135
128	140	91	140
132	140	102	140
133	146	102	144
134	148	103	150
135	151	104	150
149	154	117	152
149	158	126	167
149	159	126	178
150	*168	129	*198
180	174	139	*205
190	191	189	212
206	194	224	213
*252	219		230
259	232		257
319	241		302
	241		330
			344

*Episode data.

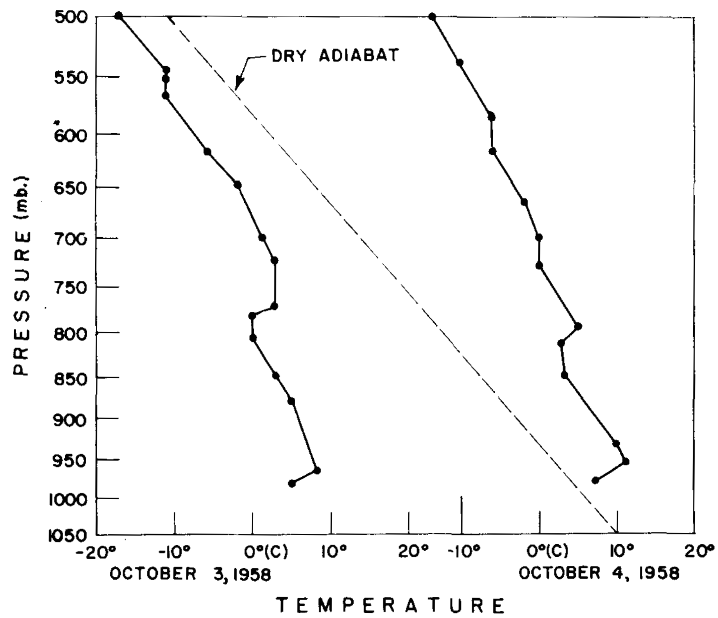

FIGURE 10.—Radiosonde observations, Pittsburgh, Pa., 0700 EST, October 3–4, 1958.

inversions at 800–850 mb. Winds above 10,000 ft. exceeded 25 kt. and above 15,000 ft. exceeded 40 kt. Surface visibility was reduced by smoke and haze along the Ohio River from Louisville to Pittsburgh.

As was expected, the weather pattern did not persist. By the afternoon of the 4th, the surface pressure gradient along the Ohio River Valley had intensified and surface winds were at least 10 kt. (fig. 11).

Recorded values were not particularly high or low except for one high sample recorded at Cincinnati. In this instance the wind records indicate that pollutants were

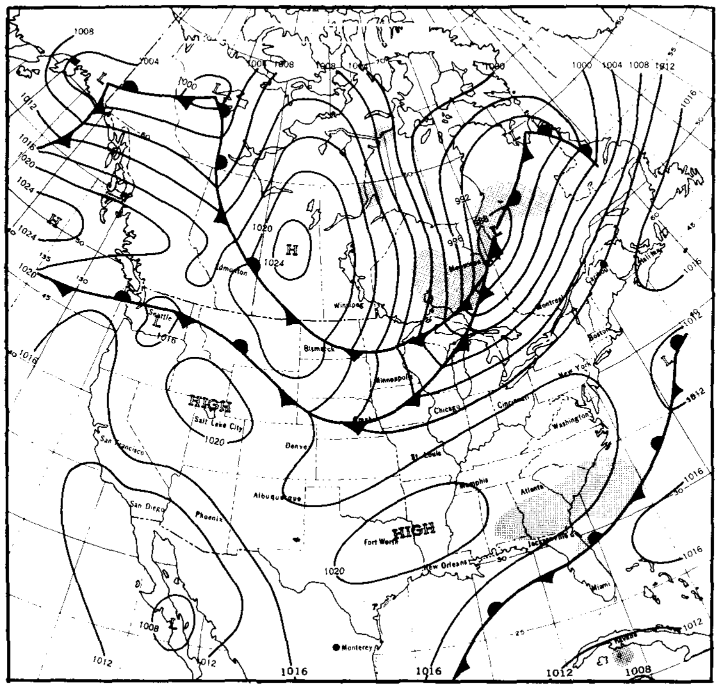

FIGURE 11.—Sea level pressure chart, 1300 EST, October 4, 1958.

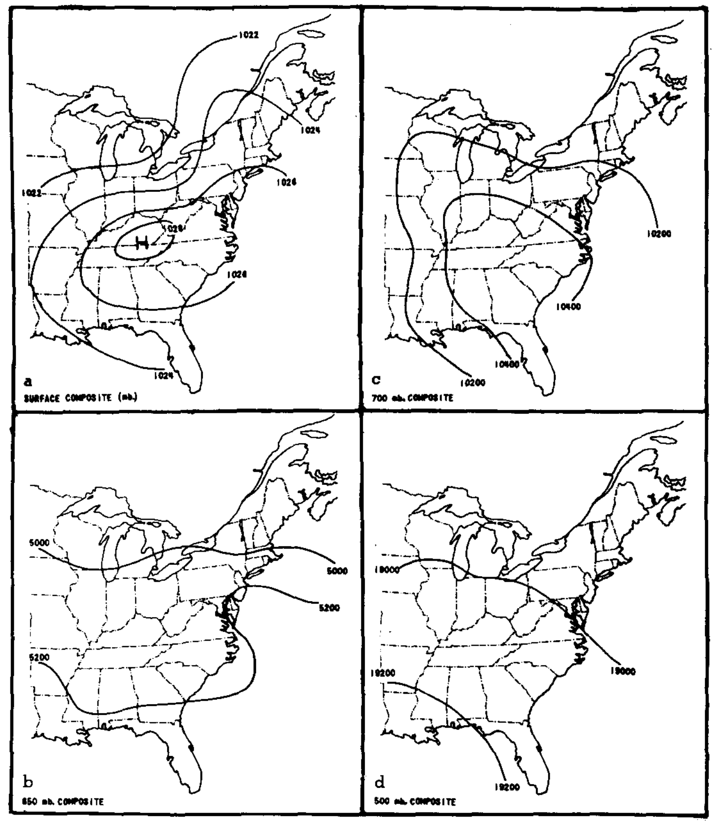

FIGURE 12.—Average meteorological charts, October 13–16, 1958. (a) Sea level composite pressure (mb.), 0100 EST. (b) 850-mb. composite height (ft.), 1900 EST. (c) 700-mb. composite height (ft), 1900 EST. (d) 500-mb. composite height (ft.), 1900 EST.

carried away from the city toward the west and southwest prior to the sampling period only to return over the city when winds shifted to the southwest. The extremely stable conditions did not permit the contaminants to mix to any appreciable height and therefore concentrations remained high.

CASE 5

In mid-October 1958, the weather over the southeastern United States was dominated by a high pressure cell, both at the surface and aloft, for a period of several days. The surface system entered the area from over the Great Plains. A strong ridge of high pressure aloft indicated that the area would be under the influence of high pressure for some time (fig. 12).

Analysis of weather charts in retrospect shows that the four stations given in table 5 were under the influence of the anticyclone from October 12 until October 17. However, winds aloft (table 6) less than 25 kt. did not become prevalent until the 13th. Subsidence was prevalent over

TABLE 5.—*Particulate matter concentrations ($\mu g. m.^{-3}$) for National Air Sampling Network Stations, 1958*

Alerted October 13–16, 1958

Asheville, N.C.	Chattanooga, Tenn.	Birmingham, Ala.	Atlanta, Ga.
45	90	46	35
45	98	53	55
47	101	68	67
48	114	96	75
49	158	*97	81
54	160	102	81
64	163	104	82
66	178	113	89
66	185	113	100
73	191	124	108
74	198	127	111
75	199	143	119
77	200	183	125
78	212	191	137
82	215	209	143
95	222	233	183
107	264	254	194
108	267	*319	200
115	268	342	210
121	376	369	241
124	*399	424	268
131	465	469	*367
179	509	640	
*188	*512		
206	528		
212	532		
*241	*549		

*Episode data.

TABLE 6.—*Wind speeds (knots) at selected stations, 0700 EST, October 13–16, 1958*

Height (meters msl)	Nashville, Tenn.				Birmingham, Ala.			Greensboro, N.C.			
	13	14	15	16	13	14	15	13	14	15	16
6000	18	18	13	16	22	M	M	36	20	16	11
5000	13	9	9	9	13	M	M	29	20	16	13
4000	13	11	2	13	11	7	M	29	18	9	9
3000	18	4	7	9	13	7	7	20	13	9	4
2500	18	2	4	11	11	4	7	18	9	4	9
2000	16	2	7	11	9	9	2	22	4	7	4
1500	11	4	4	11	13	11	7	16	2	7	9
1000	7	7	7	9	7	11	16	11	13	9	16
500	4	9	9	7	11	16	22	9	16	11	16
*300	4	9	9	7	11	16	22	11	18	13	20
*150	4	4	7	4	11	9	13	7	16	9	13
SFC	4	4	2	2	11	7	9	2	11	4	7

*Height above surface.
M = Missing.

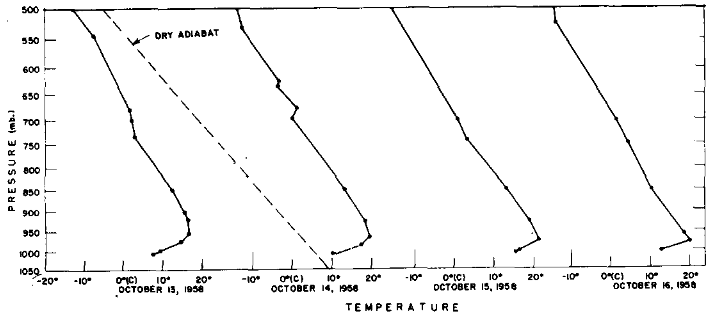

FIGURE 13.—Radiosonde observations, Nashville, Tenn., 0700 EST, October 13–16, 1958.

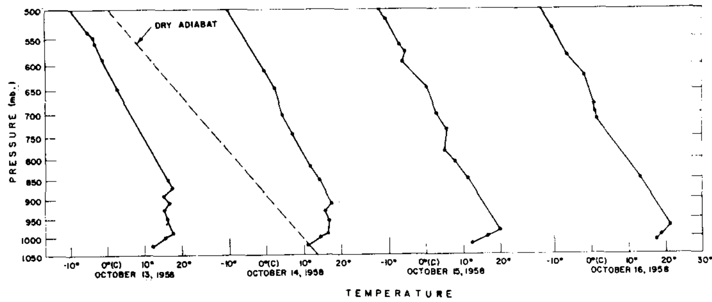

FIGURE 14.—Radiosonde observations, Montgomery, Ala., 0700 EST, October 13–16, 1958.

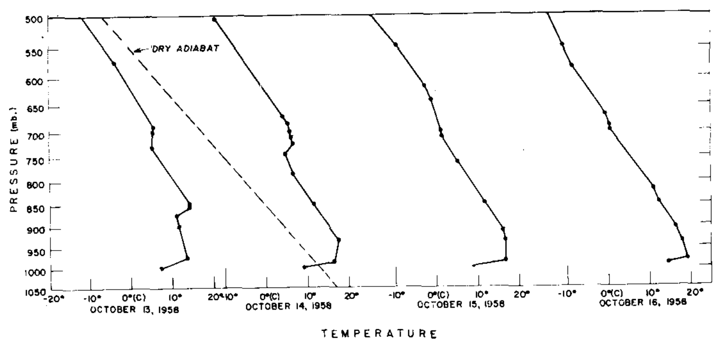

FIGURE 15.—Radiosonde observations, Athens, Ga., 0700 EST, October 13–16, 1958.

the general area until the 16th. Nocturnal surface inversions developed each night (figs. 13–15) but were apparently dissipated during the day. This circumstance was probably fortunate; otherwise, air pollution concentrations might have become severe in some areas. Fog was reported at Chattanooga and other stations but was dispelled early in the day.

In the period, October 13–16, conditions favoring maximum concentration of pollutants occurred during the night and early morning hours. Sufficient insolation was received to eliminate the surface inversions during the late morning and early afternoon. This permitted the pollutants to become dispersed into a deep layer. The winds, although light, were then instrumental in carrying the contaminants away from the cities under study.

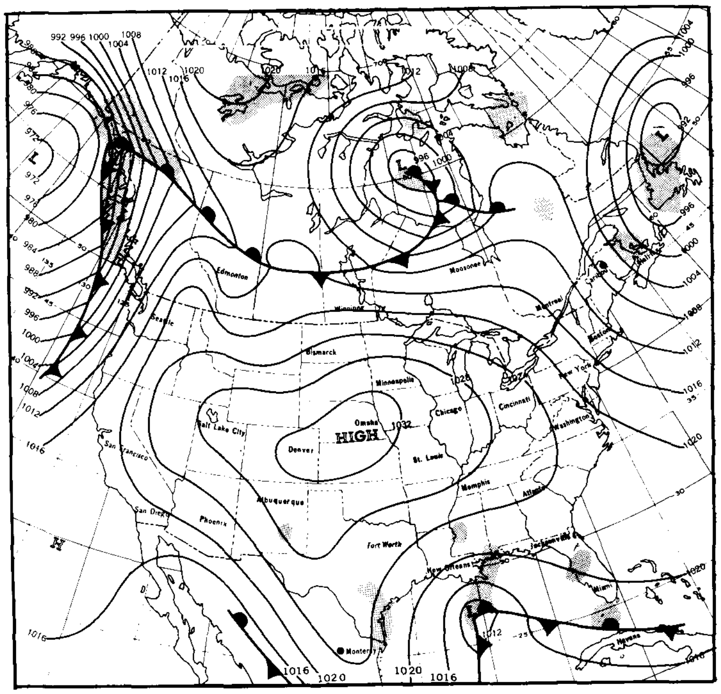

FIGURE 16.—Sea level pressure chart, 1300 EST, October 30, 1958.

In this particular period the criteria were completely fulfilled. Success of the experiment for this period is shown by the high particulate loadings at the various stations (table 5). Loadings at Atlanta and Chattanooga were among the highest recorded data attained in two years.

The low sampling value at Birmingham may be attributed to the fact that the surface winds in the Birmingham area, while light, persisted from the east and southeast during the period in which the sample was collected. With these directions, the sampled air would have had a trajectory with minimum travel over the urban area.

CASE 6

The last experimental forecast for which air quality data were requested was issued on October 30, 1958. In this instance, a high pressure cell, centered in the central Great Plains, extended its influence eastward with a surface ridge of high pressure to the Atlantic Seaboard (fig. 16). Winds at the 5,000-ft., 10,000-ft., and intermediate levels were distributed into two main currents (fig. 17). One current was directed around a low pressure system located over Newfoundland; the other current flowed around the anticyclone centered over Nebraska. This diverging wind pattern was conducive to subsidence over the States of Ohio, Indiana, Kentucky, and West Virginia. Winds aloft charts and radiosonde observations for the period show that in this area winds ranged from 10 to 20 kt. be-

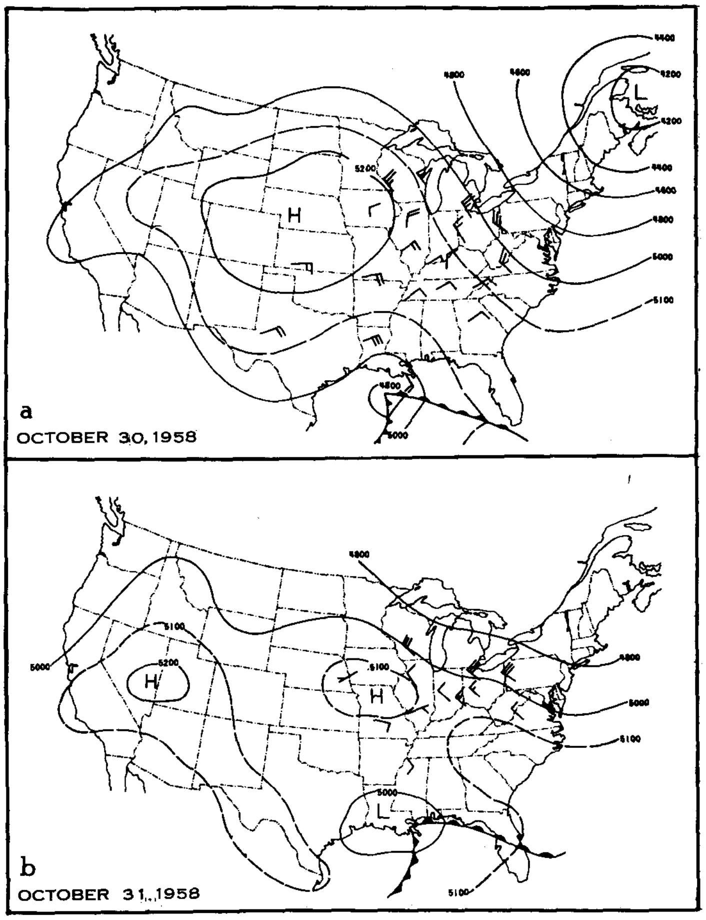

FIGURE 17.—850-mb. height chart, 0700 EST. (a) October 30, 1958. (b) October 31, 1958.

TABLE 7.—*Wind speeds (knots) at selected stations, 1300 EST, October 30–November 1, 1958*

Height (meters msl)	Indianapolis, Ind.		Cincinnati, Ohio			Dayton, Ohio		
	30	31	30	31	1	30	31	1
6000	11	20	16	27	M	18	25	22
5000	7	20	11	27	M	22	22	25
4000	13	13	13	16	M	20	16	16
3000	13	7	13	13	M	20	18	22
2500	16	11	16	16	M	18	20	29
2000	16	16	18	13	M	20	20	27
1500	20	22	16	13	20	22	20	29
1000	11	13	11	4	22	18	13	13
500	9	9	7	4	7	9	11	9
*300	9	9	7	7	9	11	11	9
*150	9	9	4	4	7	9	11	9
SFC	11	9	2	4	7	4	4	7

*Height above surface.
M = Missing

low the 5,000-ft. level (table 7), and well developed subsidence inversions and nocturnal surface inversions prevailed (fig. 18). These phenomena contributed materially to the retention of contaminants near the earth's surface. Table 8 presents the air quality data taken as a result of this alert. All values were recorded in the upper decile

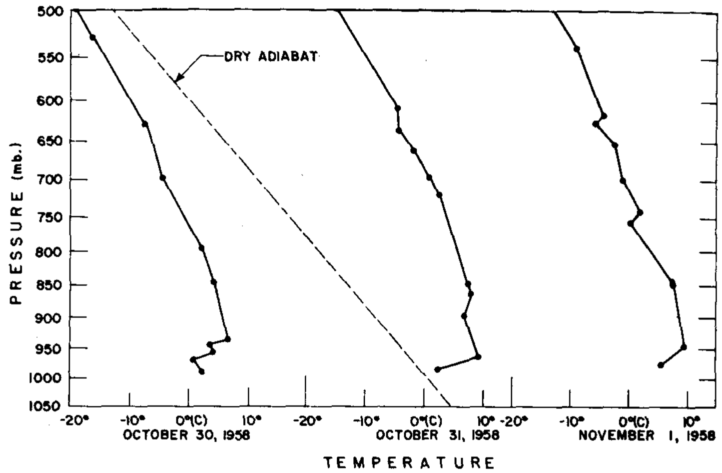

FIGURE 18.—Radiosonde observations, Dayton, Ohio, 0700 EST, October 30–November 1, 1958.

TABLE 8.—*Particulate matter concentrations ($\mu g.m.^{-3}$) for National Air Sampling Network Stations, 1958*

Alerted October 30–November 1, 1958

Charleston, W. Va.	Columbus, Ohio	Dayton, Ohio	Huntington, W. Va.	Indianapolis, Ind.	Louisville, Ky.	Cincinnati, Ohio
45	78	60	50	98	115	89
47	86	66	58	116	131	91
71	108	76	61	116	137	93
71	112	84	63	123	141	96
78	123	84	67	124	147	99
87	125	86	68	130	147	100
88	126	87	74	131	153	113
89	135	88	75	131	166	117
92	136	91	77	139	168	124
96	138	93	90	143	182	126
120	140	97	91	153	185	126
143	140	105	91	157	188	128
150	140	108	102	159	240	132
167	146	110	102	167	267	133
178	148	111	103	174	268	134
195	151	115	104	177	271	135
231	154	120	117	177	323	149
232	158	126	126	180	363	149
308	159	127	126	192	*378	149
336	*172	128	129	207	745	150
412	174	131	139	234		180
*420	191	148	154	250		190
483	194	150	*189	*297		206
*539	219	*199	224	352		259
708	232	*206		*354		*298
	241					*319
	241					
	*267					

*Episode Data.

for the year except for one value at Columbus; it was recorded in the upper quartile for the year.

6. CONCLUDING REMARKS

Examining the air quality data for the periods in which the weather was monitored, it is found that the highest loadings with few exceptions, occurred in those periods when the criteria were met (tables 9 and 10). Examination of source distribution and topography in the vicinity of the sampling sites together with a study of the wind direction patterns would probably reveal the explanation for the exceptions.

TABLE 9.—*Particulate matter concentrations* ($\mu g.m.^{-3}$)

October 1-November 15, 1957

Fort Wayne, Ind. Date		Indianapolis, Ind. Date		Lorain, Ohio Date		Columbus, Ohio Date		Lake County, Ind. Site A Date		Lake County, Ind. Site B Date		Pittsburgh, Pa. Date		Wheeling, W.Va. Date	
10/5	110	11/12	106	10/30	105	10/19	176	10/15	**121	10/15	**74	11/9	82	11/3	165
11/14	121	10/21	125	11/7	136	10/12	*226	10/14	*274	11/5	230	10/28	136	10/1	232
10/12	*185	10/9	135	10/3	298	10/14	*241	11/5	426	10/1	298	10/12	*534	10/14	*291
10/13	*198	10/28	143	10/40	*398	11/10	248	10/1	459	10/14	*305				
10/14	*244	10/14	*158			10/13	*274								
						11/1	310								

*Episode data.
**Post episode—Samples taken after termination of alert.

TABLE 10.—*Particulate matter concentrations* ($\mu g.m.^{-3}$), *September 1–November 15, 1958*

Asheville, N.C. Date		Atlanta, Ga. Date		Birmingham, Ala. Date		Charleston, W. Va. Date		Chattanooga, Tenn. Date		Cincinnati, Ohio Date	
9/21	54	10/22	111	10/16	*97	10/28	89	9/4	98	9/30	126
10/12	75	9/13	119	9/19	127	9/24	178	9/26	215	9/4	149
10/24	82	10/1	183	10/22	233	10/8	232	10/17	*399	9/3	150
10/7	95	10/15	*367	10/17	*319	10/31	*420	11/4	465	9/19	180
11/11	121			10/5	342	11/1	*539	10/16	*512	10/13	206
10/15	*188					11/14	708	10/20	528	10/30	*298
10/16	*241							11/10	532	10/31	*319
								10/14	*549		

Columbus, Ohio Date		Dayton, Ohio Date		Greensboro, N.C. Date		Huntington, W. Va. Date		Indianapolis, Ind. Date		Louisville, Ky. Date	
9/1	78	10/29	76	10/5	64	10/5	90	9/12	130	10/24	147
10/13	146	10/25	84	10/9	70	10/11	117	9/26	159	9/23	188
9/15	151	9/20	86	10/31	97	11/2	154	9/9	180	11/7	267
10/31	*172	11/19	88	10/10	108	11/1	*189	10/17	192	10/31	*378
10/17	174	10/10	93	9/7	*133			11/6	250		
10/29	194	9/3	105					10/31	*297		
11/13	232	10/31	*199					11/1	*354		
11/1	*267	11/1	*206								

*Episode data.

This experiment was performed to demonstrate that forecasts of macroscale meteorological phenomena can be used to signify periods of high air pollution potential for a large area. Although derived from limited data, the results indicate that this can be done.

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